ERBE Nonscanner WFOV Interim Edition3_Rev1 Data
36-Day, 72-Day, and Monthly Means

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1. **What is ERBE Nonscanner WFOV Edition3 Data?**

   The ERBE Edition3 data processing applies a correction factor to the nonscanner WFOV TOA fluxes to account for the degradation of the ERBS satellite orbit altitude over time.The orbital altitude affects the quadrature weights, influence coefficients, and shape factors that are used to invert the ERBE data from satellite altitude to TOA fluxes. The original ERBE data processing software did not take into account the long-term degradation of the ERBS orbit.

   In Edition3 processing, a reference altitude is defined as the November 1984 monthly mean orbit altitude, and is used to calculate the quadrature weights and influence coefficients for each day. TOA fluxes are calculated as before, and are then multiplied by an altitude-dependent correction factor that is defined as the square of the instantaneous altitude divided by the square of the reference altitude.

   The archived 15-year ERBE WFOV Nonscanner Edition3 data set is available from the NASA Langley Atmospheric Science Data Center ERBE Data and Informations.

2. **What is ERBE Nonscanner WFOV Edition3_Rev1 Data?**

   The ERBE Edition3_Rev1 data is an interim release dataset that includes additional revisions that are not included in the archived Edition3 data set. Users will need to apply the Rev1 revision adjustments to the archived Edition3 data to create the Edition3_Rev1 dataset. The method for developing these adjustments and the formula used to correct the Edition3 data are outlined below. Alternatively, users can download the subset of adjusted data from the data access page.

   a. **Tropical mean adjustment method:**

      A time series of tropical mean (20N to 20S) daytime minus night time longwave fluxes over the 15-year ERBE record shows that the tropical mean night time flux is flat over the 15 years, but the tropical mean daytime flux slopes up, indicating that the shortwave channel is decreasing in sensitivity. This residual instrument trend is not fully corrected by the bi-weekly solar calibrations that were performed on the ERBE nonscanner instrument. The most recent instrument engineering study indicated that this is mostly likely a result of non-unform exposure of the nonscanner WFOV shortwave sensor dome filter to UV radiation during spacecraft sunrise and sunset over the 15-year period. Since the daytime longwave flux is obtained from the total minus shortwave flux, the decrease in shortwave flux will result in increases in the daytime longwave flux, thus leading to the upward slope in the longwave daytime flux.

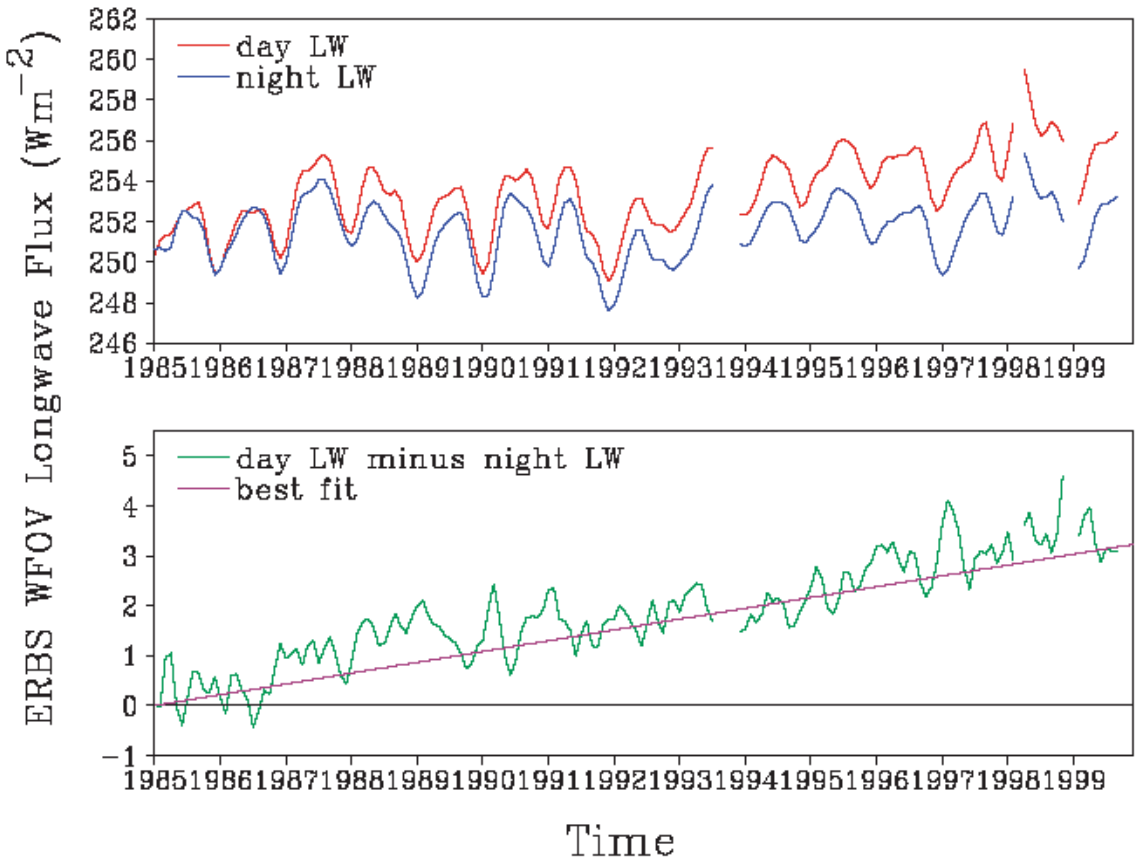

Figure 1. Time series of ERBS Nonscanner WFOV Edition3 tropical mean (20N to 20S) daytime longwave flux (top, red curve), nighttime longwave flux (top, blue curve), and day-minus-night longwave flux differences (bottom, green curve) from 1985 to 1999. The purple line on the bottom graph is the best fit line to the day-minus-night longwave differences.

A correction for this small SW dome degradation is developed using tropical mean data. Specifically, a linear regression is used to zero out the tropical daytime minus night time differences over the 15-year period. The slope of the line, B, represents the rate of adjustment that needs to be applied to the tropical mean data, and will be different for the monthly, the 36-day, and the 72-day means. The tropical mean adjustment factor is then just B*(t-1).

ERBE Nonscanner WFOV Edition3_Rev1 Tropical Mean TOA Flux Revision Adjustment Factors

	Monthly	36-Day	72-Day
B	0.00901975	0.0108237	0.0216474
t	1 - 180	1 - 150	1 - 75
B*(t-1)	Monthly Adjustment Factors	36-day Adjustment Factors	72-day Adjustment Factors

The tropical mean adjustment factor is applied to both the tropical mean Edition3 longwave flux and the tropical mean Edition3 shortwave flux to remove this small SW sensor artifact. Specifically, the tropical mean Edition3_Rev1 shortwave flux is calculated as

$$\text{Tropical Mean } SW_{\text{Edition3\_Rev1}}(t) = \text{Tropical mean } SW_{\text{Edition3}}(t) + \text{Tropical mean adjustment factor } (t) \quad \text{(Eq. 1)}$$

The tropical mean Edition3_Rev1 longwave flux is is calculated as

$$\text{Tropical Mean } LW_{\text{Edition3\_Rev1}}(t) = \text{Tropical mean } LW_{\text{Edition3}}(t) - \text{Tropical mean adjustment factor } (t) \quad \text{(Eq. 2)}$$

The tropical mean Net flux should remain unchanged since the longwave changes are completely cancelled by the shortwave changes.

b. **Generalizing the tropical mean adjustment to the rest of Nonscanner regions:**

The physics of the shortwave sensor dome degradation indicates that the amount of shortwave adjustment is a function of reflected shortwave flux incident on the shortwave senor. Since the Earth-reflected shortwave flux is highly regionally dependent, the absolute form of SW adjustments developed based on the tropical mean data, and described above, need to be reformulated into the relative form of SW adjustment in order to be useful for regional data analysis.To extend the tropical mean Edition3_Rev1 adjustments to the rest of the Nonscanner regions, a time series of Edition3_Rev1 SW adjustment scaling factors is first estimated using the time series of the tropical mean Edition3 SW flux and the time series of the tropical mean adjustment factor:

$$\text{SW adjustment scaling factor (t)} = \text{Tropical Mean } SW_{Edition3\_Rev1}\text{ (t) } \mathbf{/} \text{ Tropical Mean } SW_{Edition3}\text{ (t)} \quad \text{(Eq. 3a)}$$

or, using Equation (1) above,

$$\text{SW adjustment scaling factor (t)} = 1 + (\text{ Tropical mean adjustment factor (t) } \mathbf{/} \text{ Tropical mean } SW_{Edition3}\text{ (t))} \quad \text{(Eq. 3b)}$$

Using the time series of this Edition3_Rev1 SW adjustment scaling factor, the regional $SW_{Edition3\_Rev1}$ flux can be calculated as

$$SW_{Edition3\_Rev1}\text{ (t)} = SW_{Edition3}\text{ (t) *SW adjustment scaling factor (t)} \quad \text{(Eq. 4)}$$

Similarly, the regional $LW_{Edition3\_rev1}$ flux can be calculated as

$$LW_{Edition3\_Rev1}\text{ (t)} = LW_{Edition3}\text{ (t) - (}\ SW_{Edition3\_Rev1}\text{ (t) - }SW_{Edition3}\text{ (t))} \quad \text{(Eq. 5a)}$$

or, using Equation (4) above,

$$LW_{Edition3\_rev1}\text{ (t)} = LW_{Edition3}\text{ (t) - [}SW_{Edition3}\text{ (t) * (SW adjustment scaling factor (t) - 1)]} \quad \text{(Eq. 5b)}$$

Equations 4 and 5 can be applied to all Edition3 Nonscanner regional data, as well as to zonal mean and near-global mean results. Furthermore, Equations 4 and 5 will reduce to Equations 1 and 2, respectively, for the special case of tropical mean data. Please note again that the Edition3_Rev1 adjustment in Equations 4 and 5 affects only the Edition3 LW and SW fluxes. The Edition3 Net flux is again unchanged by this adjustment.

ERBE Nonscanner WFOV Edition3_Rev1 SW Adjustment Scaling Factors

Monthly	36-Day	72-Day
SW_monthly_scale_factors	SW_36day_scale_factors	SW_72day_scale_factors

3. **What are the 36-day and 72-day regional means?**

The 72-day and 36-day regional means are based on the ERBE Edition3 WFOV shape factor S10n record one daily means of shortwave and longwave TOA fluxes, daily mean albedo, and integrated solar incidence over a day. These values were extracted from the S10n data file for each 10-degree region for each month of the data set (January 1985 - September 1999). Note that although

ERBE Edition3 data are available for November and December 1984, the 72-day and 36-day means were not calculated for 1984. The resulting monthly files of the Edition3 daily means of shortwave flux, longwave flux, albedo, and solar incidence were combined into yearly files, from which the 36-day and 72-day regional means were calculated. The Rev1 revision adjustment factor was then applied to the calculated 36-day and 72-day regional means to create the Edition3_Rev1 36-day and 72-day regional means.

Mean Longwave Flux:

The individual daily mean values of longwave flux in a given region were summed, and the sum was divided by the number of daily means in that region.

Mean Solar Incidence:

The individual daily values of integrated daily solar incidence in a given region were summed for all days, and the sum was divided by the number of daily values in that region. The integrated daily solar incidence is calculated theoretically during ERBE data processing; it is not measured by the ERBE isntruments.

Mean Albedo:

The individual daily mean values of shortwave flux in a given region were summed. The individual daily values of integrated daily solar incidence in that region were summed for those days for which there were shortwave flux data. The mean albedo is then defined as 24*(sum of SW measurements)/(solar incidence summed over shortwave days).

Mean Shortwave Flux:

The mean shortwave flux is defined as (mean albedo)*(solar incidence summed over all days)/(24*N), where N is the number of days over which the mean is being calculated, either 36 or 72. Here the solar incidence is summed over all days, whether or not a shortwave flux value is available for that day.

Mean Net Flux:

The net flux is defined as ((1-mean albedo)*(solar incidence summed over all days)/(24*N)) - (mean longwave flux), where N is the number of days over which the mean is being calculated, either 36 or 72.

4. **What are the monthly regional means?**

The monthly regional means are based on the ERBE Edition3 WFOV shape factor S10n record one monthly (hour) means of shortwave, longwave, and net TOA fluxes, albedo, and integrated total solar incidence. These values were extracted from the S10n data file for each 10-degree region for each month of the data set (January 1985 - September 1999). Note that although ERBE Edition3 data are available for November and December 1984, these data months were not used for this analysis. The Rev1 revision adjustment factor was then applied to these monthly regional means to create the Edition3_Rev1 monthly regional means.

5. **What are the 36-day, 72-day, and monthly near-global and tropical means?**

Once the regional means were calculated, near-global (60N - 60S) and tropical (20N - 20S) area-weighted means were calculated for each 36-day and 72-day cycle, and for each month. In order to be consistent with ERBE S4N data processing, zonal means are first calculated for each 10-degree latitude zone, and near-global and tropical means are then calculated from the zonal means.

Zonal means were calculated for longwave, shortwave, and net flux, and for total integrated solar incidence by summing the corresponding values in each latitude zone and and dividing by the number of values.Note that zonal means are not area-wieghted since each region in a given latitude zone has the same area.

Area-weighted near-global means of longwave, shortwave, and net flux and total integrated solar incidence were calculated by summing the products of the zonal mean and the region area of the given zone over all zones between 60N and 60S latitude for which zonal means were available, and dividing by the sum of the area weights of the zones for which data were available. Note that this differs from the method used in the ERBE S4 and S4n data processing system for determing the near-global mean shortwave flux. In the S4 and S4n ERBE processing the near-global shortwave flux calculations include values of zero flux for those zones that are in darkness for the entire month. Thus the near-global SW flux determined from the ERBE S4 data processing will be slightly smaller for some months than that reported here. Values of solar incidence reported here have been divided by the number of hours in the averaging period (36 days, 72 days, or one month).

Area-weighted tropical means of longwave, shortwave, and net flux and total integrated solar incidence were calculated in the same way, but included data only in zones between 20N and 20S latitude.

These area-weighted means, as well as the regional means, can be accessed from the links at the top of this document. Note that no data are available for August, September, October, and November 1993; March 1998, December 1998, and January 1999 because of spacecraft problems.

6. **How to reference these data:**

To differentiate this interim data release from the official archived release at the Langley ASDC, the revised Edition3 data with the shortwave dome adjustment will officially be referred to as the ERBE_S10N_WFOV_ERBS_Edition3_Rev1 data set.

Please provide a reference to the following paper when you publish scientific results with the ERBE/ERBS Nonscanner WFOV Edition3_Rev1 data:

Wong, T., B. A. Wielicki, R. B. Lee, III, G. L. Smith, K. A. Bush, and J. K. Willis, 2006: Re-examination of the Observed Decadal Variability of Earth Radiation Budget using Altitude-corrected ERBE/ERBS Nonscanner WFOV data. J. Climate, 19, 4028-4040.

7. **News and updates:**

- **December 02, 2009:** Added journal reference to be included in papers published using the ERBE/ERBS Nonscanner WFOV Ediition3_Rev1 data.
- **July 19, 2005:** ERBE Nonscanner WFOV Interim Edition3_Rev1 Data Website is now opened to the public.
- **October 19, 2005:** Updated Edition3_Rev1 Website with regional SW adjustment scaling factor information to allow for more precise handling of regional adjustments. Tropical mean adjustment information is unaffected by this regional update.
- **November 14, 2005:** Updated all Edition3_Rev1 regional ASCII data files in the data access webpage using regional SW adjustment scaling factor. Tropical mean ASCII data files are unaffected by this regional update.